

# Integration of Industrial Environmental Information Systems

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## Summary

This paper presents some of the results from the IMPRESS project, running from October 2004 to September 2006. IMPRESS (Implementation of Integrated Environmental Information Systems) aimed at implementing method and tool integration with corporate business processes in a number of industrial companies. The research and development work was performed by the research group Industrial Environmental Informatics (IMI) at Chalmers University of Technology, and the industry was represented by seven companies, all members of the Swedish competence centre Center for environmental assessment of Product and Material systems (CPM) which also funded the project.

In the IMPRESS project a general method for integration of industrial environmental information systems has been developed. Further a demonstration tool called VIEWS (Visualization of Integrated Environmental Work Spaces) was created based on the integration method. An overview of the integration method and of VIEWS is presented in this paper, and an extensive description of these results is available as a report.

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## INTRODUCTION

This paper presents some of the results from the IMPRESS project, running from October 2004 to September 2006 [1]. IMPRESS (Implementation of Integrated Environmental Information Systems) aimed at implementing method and tool integration with corporate business processes in a number of industrial companies. The research and development work was performed by the research group Industrial Environmental Informatics (IMI) at Chalmers University of Technology, and the industry was represented by seven companies, all members of the Swedish competence centre Center for environmental assessment of Product and Material systems (CPM) which also funded the project.

In the IMPRESS project a general method for integration of industrial environmental information systems has been developed. Further a demonstration tool called VIEWS (Visualization of Integrated Environmental Work Spaces) was created based on the integration method. An overview of the integration method and of VIEWS is presented in this paper, and an extensive description of these results is available as a report [2].

## OBJECTIVE AND SCOPE

The intended purpose of the integration method is to make industrial environmental information systems more effective and efficient, i.e. to decrease cost for developing, using and maintaining data, tools, and methods for industrial environmental management and to improve controllability of environmental performance. VIEWS was developed to demonstrate in how environmental management tools can be integrated in practice.

The scope of the integration method is limited to industrial environmental management responsibilities. However it is general in the sense that it is independent of line of business, quality requirements, technology, methods, tools, and concept and data models. Integration in this context refers to integration of environmental information management methods and

tools, i.e. integration with each other and with corporate business processes. For example, from an environmental responsibility perspective, it may be relevant to incorporate product development, sales and marketing, and material management in an integration effort.

The practical integration of tools within VIEWS include previously separate environmental management databases and tools for Life Cycle Assessment (LCA), Environmental Management Systems (EMS), Design for Environment (DfE), Chemical Risk Management (CRM) and Emission Trading Scheme (ETS).

## INTEGRATION METHODOLOGY

### *Method development*

In the method development, previous research results and conclusions regarding integration were studied and analysed. Based on this a set of general principles and dimensions to consider when integrating was formulated together with a work procedure consisting of three main steps: analysis, synthesis, and implementation. Three case studies at the companies ITT Flygt, SCA Hygiene Products and Akzo Nobel, were run in parallel to continuously test and refine the method and its description. The development of VIEWS was done as a final case study performed internally at IMI. A reference group was also formed, consisting of representatives from the industrial partners in CPM and personnel from IMI, as a forum to discuss the method development. The reference group involved representatives from companies participating in CPM that were both involved and those not involved in the case studies and IMPRESS.

The general integration method is based on previous work with integration of environmental information and applications within the research group Industrial Environmental Informatics (IMI) and CPM [3][4]. Three basic reference models developed at CPM and IMI constitute the foundation and describe the basic integration principles in this method. These reference models presents structured ways of analysing information, e.g. in perspective of basic data structure, aggregation of data, or communication in the control system. This enables the identification of gaps and overlaps in implemented information systems. These are used as base for analyzing information systems. The information model of SPINE, that defines a generic scope and provides a structure for environmental information [5]. A corresponding integrated data format has also been developed in the IMPRESS project combining several previously developed formats [6]. A cybernetic navigation model, that describes the strategic role of environmental information systems, which is to provide decision

support for efficient and effective control of the sustainability performance of a system, in line with continuous improvement and sustainable development [7]. The reference model PHASES (PHASES in the design of a model of a System), which is a procedural description that structures information about a model of a system, i.e. how primary data is defined and acquired, aggregated into system models and communicated [8].

### *Method procedure*

The practical work procedure in the method for integration of industrial environmental information systems consists of three main steps: Analysis, Synthesis and Implementation.

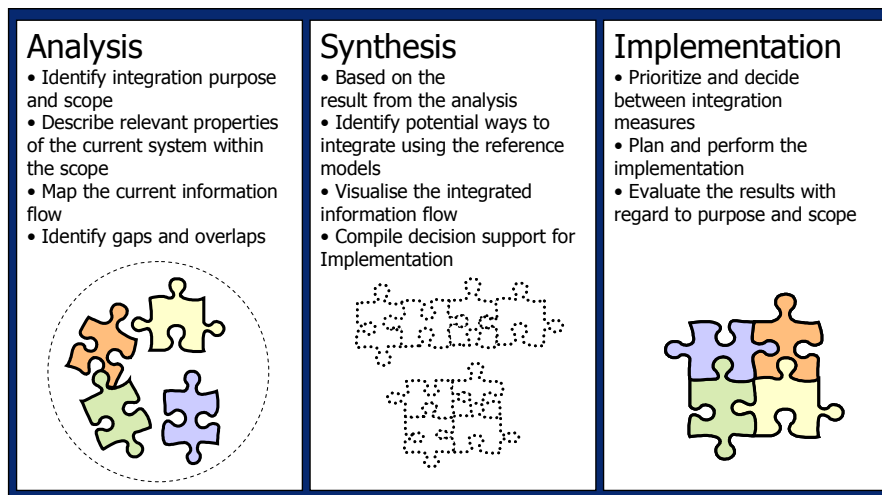


Figure 1 Overview of the three main procedural steps in the method for integration of industrial environmental information systems

In the analysis step, information about the system to be integrated is gathered together with the stakeholders. The current information system is described in terms of purpose and scope, indicator relevance, data quality requirements, actual inputs and outputs of information, tasks, users, competence needs, data formats and software used, etc. A questionnaire to the system stakeholders has been designed, to gather sufficient information about the system for a first analysis. An efficient tool also applied is the drawing of pictures together with the stakeholders to visualise of key elements of the information flow in the system. Figure 1 shows the graphical representation for the pictures; a general structure of an information task with inputs and outputs of information. Such tasks can be connected to each other where, ideally, the information required from and generated by each task is matching. Based on this, gaps and overlaps are identified. Also, a draft vision of the integrated information system is described to visualize the intended purpose and scope of the integration.

In the synthesis step the information gathered in the analysis is used to identify and describe possible ways to integrate and rebuild the system overcoming gaps and overlaps. Examples of integration measures are technical development, education of users, data acquisition, data reformatting, etc. Iteration between analysis and synthesis may be needed to refine the information gathered about the system. The reference models are very useful in this step as they provide generic principles for efficient and effective environmental information systems. A clearly defined scope and purpose is also crucial as guidance when synthesising feasible and relevant integration measures to be implemented. The result of the synthesis is compiled as decision support for the implementation.

Based on the result from the synthesis, the stakeholders decide what to actually implement. Additional information may be complemented for the decision, e.g. feasibility studies with regard to cost, competence, maintenance, or other relevant consequences outside the integration scope. The implementation is planned in terms of budget, actions, deliverables etc. The implementation should also include an evaluation is recommended with regard to the integration purpose and scope.

## VIEWS

VIEWS (Visualization of Integrated Environmental Work Spaces) is a demonstration tool visualization of what it may look like to work with environmental management tools that are integrated in reality. It is implemented as a web-based software platform [9] combining previously separate environmental management tools: Life Cycle Assessment (LCA), Environmental Management Systems (EMS), Design for Environment (DfE), Chemical Risk Management (CRM) and Emission Trading Scheme (ETS). Primary data can be shared between the tools. The primary data is aggregated in different ways by the different tools, though sometimes also at higher aggregation levels, the methods and data are identical and thus shared within VIEWS. An example is process data that is used for both LCA and EMS.

### *Conceptual illustration of VIEWS based on reference models*

The work with VIEWS is based on the general integration method. The reference models PHASETS and SPINE have been used to create a conceptual illustration of VIEWS, see figure 2. The base of the hexagonal cylinder represents the shared primary data structure, where data is defined and documented using the SPINE model. Each side of the shape

correspond to an environmental management method and tool where one of the sides is the PHASETS reference model.

The PHASETS model is followed for the aggregation of primary data for each tool. In the Design for Environment tool, material content of a product together with environmental properties of these materials are examples of primary data that will be aggregated into a report of environmental performance of the product. In the LCA tool, emissions and resource consumption of the system studied and environmental impact models are primary data that will be aggregated to a life cycle impact assessment result. The same procedure is followed in all the tools in VIEWS.

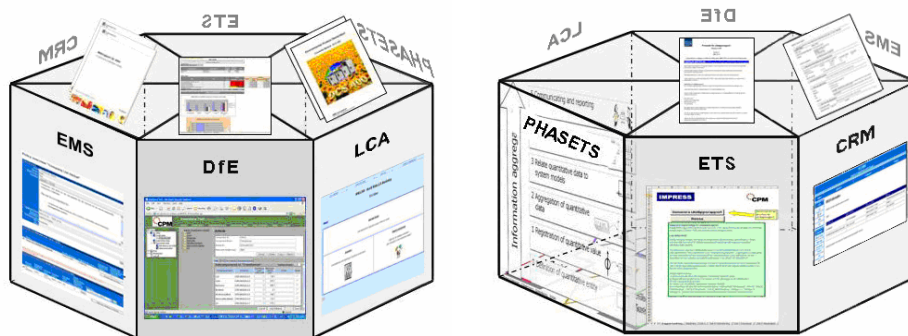


Figure 2. VIEWS is illustrated as a hexagonal cylinder where one side is the reference model PHASETS and the five other sides the five different work spaces: Life Cycle Assessment (LCA), Environmental Management Systems (EMS), Design for Environment (DfE), Chemical Risk Management (CRM) and Emission Trading Scheme (ETS). In the bottom is the common database format and in the top reports from each tool. Note that the cylinder can have any number of sides depending on how many tools are included.

The management of policy and indicators are also integrated between the tools in VIEWS. A common qualitative policy can be specified. Quantitative indicators are then selected for relevant for each tool based on this policy [10], [11]. This provides a support to the users of the different tools to quantify environmental performance based on common environmental concerns.

#### *VIEWS is used to explain integration of environmental management tools*

One of the aims with the project IMPRESS was to explain how environmental information, methods and tools in an industrial company can be integrated with each other and with the corporate business processes and also implemented into the different parts of the organisation. The demonstration tool VIEWS was constructed to visualize the integration to make it more comprehensible. For example, if process data, e.g. energy con-



sumption, is changed in the EMS user interface, the LCA data is immediately updated; if the fuel consumption data is documented in the ETS user interface, it is immediately available to the EMS tool. This way it shows how different environmental methods and tools are connected and can serve as a basis for discussions of advantages and disadvantages with integration.

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